by 1.25 to reduce the area.

Goldsmith, Bergin & Lis (1997) also image a 12′×12′ region centred on M42 at 450μ, 790μ, and 1100μ.
They also give integrated fluxes, which I again divide by 1.25 to reduce the area somewhat. I should really divide by about 1.8 to get to 80 □′, but I am weighting the outer regions less than the inner ones here, so excluding them reduces the flux by less than the geometric area reduction. Admittedly I do this reduction in a somewhat arbitrary manner...

True, but an OK guess.

At 1100μ, the authors estimate about 20% of the flux is from free-free emission while the rest is thermal dust emission kicking in. Incidentally they find $\beta \simeq 1.8$ for the Orion Nebula.

Ristorcelli et al. (1998) use a 3.5′ beam for their flux results. This has about 10 □′, so I multiply their results by 8 to get total fluxes, again under the uniform emission hypothesis. They have data at 90μ, 210μ, 270μ, 380μ, 630μ, and I have used all of these data points on my plot.
The peak of the ~~[illegible]~~ dust spectrum seems to be somewhat ~~[illegible]~~ higher frequency than 3.3THz (90μ).

For the nearer infrared — higher ν than the dust BB peak — I used the data of Simpson et al (1998) who took MSX spectra of the nebula.
Their beam was ~6′×9′, so I didn't correct their results for area — they are close enough.
I used Fig. 2, where they plot F_λ against λ.
I convert to F_ν via $F_\nu = F_\lambda \left(\frac{\lambda^2}{c}\right)$. They plot I_ν, so I convert this to a flux by multiplying by the solid

angle I am using i.e. 80 □′.
I picked 3 points on their graph 6μ, 10μ, and 25μ, corresponding to 5×10^{13} Hz, 3×10^{13} Hz and 1.2×10^{13} Hz.

These points, taken ~~all~~ altogether, show the dust spectrum very well with a clearly defined peak around 7×10^{12} Hz, indicating a dust temperature in the region of $60K \lesssim T_{DUST} \lesssim 100K$.

Near infrared (1μ–3μ) information was hard to come by and I couldn't find any satisfactory references. There are many references to line emission, but this is not important to the overall flux.
OK one paper – Hyland et al (1984). They look at small regions in Orion & conclude that lines contribute at most 16% of the flux in the 2μ window, even counting the prominent H_2 line.
Their spectrum in Fig 1, shows some continuum increasing to longer wavelength.

Mostly point-source surveys in near IR – hard to map extended emission & correct properly for bkgd – but can (& is) be(ing) done.
See L-band work of (Haisch et al. (2000x)

IR References

Bally, J., Langer, W.D., Liu, W. 1991, Ap.J., 383, 645.

Keene, J., Hildebrand, R.H., Whitcomb, S.E., 1982, Ap.J., 252, L11.

Lis, D.C., Serabyn, E., Keene, J., et al. 1998, Ap.J., 509, 299.

Goldsmith, P.F., Bergin, E.A., Lis, D.C., 1997, ApJ., 491, 615.

Ristorcelli, I., Serra, G., Lamarre, J.M., et al. 1998, Ap.J., 496, 267.

Simpson, J.P., Witteborn, F.C., Price, S.D., Cohen, M. 1998, Ap.J., 508, 268.

Hyland, A.R., Allen, D.A., Barnes, P.J., Ward, M.J. 1984, MNRAS, 206, 465.

3) Optical / UV

I found B & V data for emission from the nebula in Greve, Van Genderen & Augusteijn (1993) - this was surprisingly hard to find.
They give the Johnson Visual (V) & Blue (B) magnitudes of the nebula as a function of distance from the centre (trapezium). They use a radial brightness profile which they fit with their data.
To a radius of 300" they find V = 3.67 mag B = 3.97 mag. For reference the trapezium stars (summed) have V = 4.69 mag, so the nebula far outshines the stars. See Table 3 for more details.
I converted this to flux using ~~the~~ Zombeck's ~~[illegible]~~ HSA&A p100, which lists the flux from Vega in Johnson V & B filters. Vega is defined to have mag = 0.

So $m_1 - m_2 = 2.512 \log f_2/f_1$ 2 = vega $m_2 = 0$

$$\rightarrow f_1 = f_2 \exp\left[-\frac{m_1}{2.5}\right]$$

- f_2 is from the table in Zombeck
- m_1 is from Greve et al data.

In UV, I found Bohlin et al's (1982) treatment to be the most comprehensive & helpful, especially Table 3. They give the integrated flux from the nebula in 4 wave bands for lots of annuli around the centre of the nebula. To get the total flux out to some radius you just sum the ~~columns~~ annuli out that far. They also give the stellar flux from θ_1 Ori and θ_2 Ori combined, & this is larger than the nebulous flux out to r=5'.
So for the first time, the stellar spectra are now dominating the spectrum.
I integrated nebulous emission out to 4.4' (the nearest contour to 5') and added this to the stellar fluxes to get the total signal. Bohlin et al. get the stellar fluxes from Bohlin & Savage (1981).

For an O star with $T_{eff} = 40{,}000$ K, the peak of the BB curve is at 710 Å (peak in wavelength) so it is not surprising that the flux is increasing to shorter wavelengths. ~~[illegible] to get [illegible]~~ (Bohlin et al look at 1820 Å < λ < 2420 Å).

Again to get to F_ν I use $F_\nu = F_\lambda \frac{\lambda^2}{c}$

Optical/UV references

Greve, A., Van Genderen, A.M., Augusteija, Th., 1993, A&AS, 99, 577.

Bohlin, R.C, Hill, J.K., Stecher, T.P., Witt, A.N. 1982, Ap.J., 255, 87.

Bohlin, R.C., & Savage, B.D., 1981, ApJ., 249, 109.

Zombeck, M. V. 1990 "Handbook of Space Astronomy & Astrophysics" p100.

4) XRay

Useful for getting an idea of the region is Garmire et al. (2000). They took Chandra ACIS data of the nebula & explain well what's going on. Their resolution is just too good though.

Much more useful is Yamauchi et al. (1996). They took ASCA data of the orion nebula & integrated over a 6' region around the trapezium. This is close enough to my radius, and X-ray data is uncertain enough, that there is no need to do an area correction.

Page 733 figure 6(e) is the one I used to get spectra. Unfortunately this spectrum, while nicely integrated over the area, is convolved with the detectors frequency response. To deconvolve, I used a Chandra utility on the www which will convert ASCA counts into a flux in erg $cm^{-2} s^{-1}$ over a specified energy range (thanks to Craig Heinke for this).

URL is http://asc.harvard.edu/toolkit/pimms.jsp

I input a Raymond-Smith source model, $N_H = 2 \times 10^{21}$ cm^{-2}, $T = 3 \times 10^7$ K, & the count rate from various parts of the curve in fig. 6(e). These are the parameters that Yamauchi et al ~~~~ either input to their best fit model or derive from that model.

As expected the flux is much lower in X-ray than in O/IR. This flux seems to be dominated by a very hot plasma at $T \sim 3 \times 10^7$ K, due to shocks from stellar winds, outflows or ionization / radiced shocks which are known to be present in Orion.

X-Ray References

Garmire, G., Feigelson, E.D., Broos, P., et al. 2000, A.J., 120, 1426.

Yamauchi, S., Koyama, K., Sakano, M., Okada, K., 1996 P.A.S.J., 48, 719.

Heinke, C. (private communication)

Summary

Overall the region looks much like I expected when I drew a "guessed" spectrum last week (in 30 minutes.):

- Free-Free dominates radio emission
- Thermal dust emission dominates submm/IR
- Starlight or scattered starlight dominates Optical + Near IR.
- UV is dominated by stellar emission
- X-ray is mostly high temperature plasma.

I expected the optical or UV light to dominate though, whereas the IR contains most of the power output. This is because of the BN/KL nebula which is an obscured region of massive star formation. It is invisible at short wavelengths and almost all its luminosity comes out in the IR. It is located within 1' of trapezium, so it is all contained in my field of view.

Line cooling is of course important in the HII region, so some spectra I saw have huge Hα and OIII and SIII emission lines, but I have not plotted these as they do not contribute much overall power as compared to the continuum. Also, there are so many lines on such a wide range of frequency, that there's no way I could even put in a representative sample.

My spectrum looks like a cross section of one of my back teeth or gum...

Appendix A : Spectral Coverage

λ	ν	Band	Coverage		
1m	300MHz	radio			
10cm	3GHz	radio	20cm 324Jy	Gaudio points	
1cm	30GHz	cm	23GHz 400 Jy	d = 10'	
			3.5mm 307Jy	10'×10'	
1mm	300 GHz	mm	1.1mm 989 Jy	12'×12'	
			790μ 2671	12×12	
			↕ good coverage!		
			210 35500	d=3.5'	
100μ	3THz	FIR	90μ 250kJy	d=3.5'	
			25μ 18 GJy/sr at peak	? ✓	→ r=5'
			25μ		
10μ	3×10^{13}	MIR	12μ 5GJy/sr at peak	? ✓	
			10μ		
			6μ		
1μ	3×10^{14}	NIR	B= 4400Å, V=5580Å	? ✓	
		optical	2420Å, 2240Å, 1820Å, 1400Å — Bohlin et al	? ✓	
0.1μ=100nm	3×10^{15}	UV			
100Å	3×10^{16}	0.1keV	?		
10Å	3×10^{17}	1keV	$L\sim10^{33}$ erg/s in 0.5–10keV	✓	
			better – 3 data points		

Appendix B: Data used

Band	Freq (Hz)	F_ν	νF_ν
Radio	42×10^{6}	74×10^{-26}	
	240×10^{6}	120×10^{-26}	
	600×10^{6}	268×10^{-26}	
(20cm)	1.4×10^{9}	324×10^{-26}	
	5×10^{9}	380×10^{-26}	
(1cm)	23×10^{9}	400×10^{-26}	
	86×10^{9}	307×10^{-26}	
(1.1mm)	273×10^{9}	800×10^{-26}	
	380×10^{9}	2136	
SubMM	480	14000	
	670	16000	
FIR	750	60000	
	790	50000	
	850	48000	
	1.1×10^{12}	0.13×10^{-20}	
MIR (90μ)	3.3×10^{12}	2.0×10^{-20}	
25μ	1.2×10^{13}	?? ~~8200×10^{-26}~~ IRAS points, no good	2.4×10^{-21}
~~12μ~~	~~2.5×10^{13}~~	~~1410×10^{-26}~~	
10μ	3×10^{13}	11000×10^{-26}	
5μ	5×10^{13}	1000×10^{-26}	
V	5.45×10^{14}	510×10^{-26}	
B	6.8×10^{14}	910×10^{-26}	
UV	1.24×10^{15}	815×10^{-26}	
	1.33×10^{15}	230×10^{-26}	
	1.64×10^{15}	190×10^{-26}	
	2.14×10^{15}	333×10^{-26}	
X 0.5keV	1.2×10^{17}	1.6×10^{-32}	
1keV	2.41×10^{17}	5.5×10^{-32}	
5keV	1.8×10^{18}	1.0×10^{-33}	